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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
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EXAMINER

HU.S

ART UNIT PAPER NUMBER

2811

DATE MAILED: 08/03/00

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary

Application No.
09/329,156

Applicant(s)
Qu et al.

Examiner
Shouxiang Hu

Group Art Unit
2811



☒ Responsive to communication(s) filed on May 19, 2000

☒ This action is **FINAL**.

☐ Since this application is in condition for allowance except for formal matters, **prosecution as to the merits is closed** in accordance with the practice under *Ex parte Quayle*, 35 C.D. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire three month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

Disposition of Claim

☒ Claim(s) 1-12 is/are pending in the application.

Of the above, claim(s) _____ is/are withdrawn from consideration.

☐ Claim(s) _____ is/are allowed.

☒ Claim(s) 1-12 is/are rejected.

☐ Claim(s) _____ is/are objected to.

☐ Claims _____ are subject to restriction or election requirement.

Application Papers

☐ See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.

☐ The drawing(s) filed on _____ is/are objected to by the Examiner.

☐ The proposed drawing correction, filed on _____ is ☐ approved ☐ disapproved.

☐ The specification is objected to by the Examiner.

☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

☐ All ☐ Some* ☒ None of the CERTIFIED copies of the priority documents have been received.

☐ received in Application No. (Series Code/Serial Number) _____.

☐ received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

*Certified copies not received: _____

☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

☒ Notice of References Cited, PTO-892

☒ Information Disclosure Statement(s), PTO-1449, Paper No(s). 4

☐ Interview Summary, PTO-413

☐ Notice of Draftsperson's Patent Drawing Review, PTO-948

☐ Notice of Informal Patent Application, PTO-152

— SEE OFFICE ACTION ON THE FOLLOWING PAGES —

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DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. Claims 1-12 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claims 1 and 10 recite the limitation of two layers being “coextensive therewith.” However, the word “coextensive” may have some different meanings, including: having the same limits, boundaries or scopes; and not all of these meanings are exactly suitable to Applicant’s claimed invention. According to Applicant’s disclosure, for example, the first and the second epitaxial layers do not share a same height, even though they do share the boundaries between them.

Claim Rejections - 35 USC § 102 and 103

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless --

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(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 1-12, insofar as in compliance with 35 U.S.C. 112, are rejected under 35 U.S.C. 103(a) as being unpatentable over Muramoto (4,884,113).

Muramoto discloses (Figs. 3-8) a semiconductor device comprising: A semiconductor substrate (10a); a N⁻-type first deposited layer (10b); a N⁺-type second deposited layer (the horizontal portion of 12); a plurality of P-type layer (13) on the surface of the second deposited layer and defining p-n junctions therein, wherein the first layer and the second layer share the boundaries between them.

Although Muramoto does not explicitly disclose that the semiconductor substrate is a silicon substrate, it is noted that silicon substrate is the most commonly used semiconductor substrate. Therefore, ordinary skilled in the art would be able to recognize that a silicon substrate can be used as the semiconductor substrate to form Muramoto's semiconductor device.

In addition, although Muramoto does not explicitly disclose which process is used to form the deposited layers, it is noted that it is old and well known in the art that epitaxial

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deposition is one of the most widely used processes to form semiconductor layers. Besides, the process limitations of “epitaxially deposited” or “separately deposited” recited in claims 1-12 would not carry patentable weight in these claims drawing to a structure, because distinct structure is not necessarily produced. In re Thorpe, 227 USPQ 964, 966 (Fed. Cir. 1985).

Regarding claim 2, the N⁺-type second deposited layer (12) has a resistivity intrinsically lower than the one in the N⁻-type first deposited layer (10b).

Regarding claims 3-8 and 12, Muramoto discloses that higher reverse bias voltage can be obtained with the bi-layer structure. Therefore, Muramoto’s device is intrinsically capable of having the total thickness of the first and second layers thinner than the thickness of a single layer designed to block a same voltage.

Regarding claims 9 and 10, Muramoto’s device is a vertical DMOS, which is one of the various types of MOSFET and can be used in conduction power applications. The thickness of the bottom portion (10b) is more than 50% of the total thickness of the upper portion (12) and the bottom portion.

6. Claims 1, 2 and 9, insofar as in compliance with 35 U.S.C. 112, are further rejected under 35 U.S.C. 102(b) as being anticipated by Merrill et al. (5,661,314).

Merrill et al. (5,661,314) disclose a semiconductor device (Figs. 4 and 20), comprising: a silicon substrate (51); a first epitaxial silicon layer (52); a second epitaxial silicon layer (180); and a plurality of opposite type diffusion regions (81).

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7. Claims 3-8 and 10-12, insofar as in compliance with 35 U.S.C. 112, are rejected under 35 U.S.C. 103(a) as being unpatentable over Merrill et al. (5,661,314).

The disclosure of Merrill et al. (5,661,314) is discussed as applied to claims 1, 2 and 9 above. Although Merrill et al. (5,661,314) do not expressly disclose that the first layer is thicker than the second layer and/or the doping concentrations in the first and the second layer forming a graded profile, it is noted that the thicknesses of the individual layers and the doping profile are all well recognized parameters of importance subject to routine experimentation and optimization.

Therefore, it would have been obvious to one of ordinary skilled in the art at the time the invention was made to make the semiconductor device of Merrill et al. (5,661,314) with the first layer being thicker than the second layer and/or the doping concentrations in the first and the second layer forming a graded profile through routine experimentation and optimization, so that low on-resistance and high breakdown voltage can be achieved.

8. Claims 1-12, insofar as in compliance with 35 U.S.C. 112, are further rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Hshieh et al. (5,689,128).

Hshieh et al. (5,689,128) disclose a semiconductor device (Figs. 2 and 3), comprising: a semiconductor substrate (10); a first epitaxial semiconductor layer (12); a second epitaxial semiconductor layer (34) thinner than the first layer; and a plurality of opposite type diffusion

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regions (14 and 36). Although Hshieh et al. (5,689,128) do not explicitly disclose that the semiconductor material is silicon, it is noted that silicon is the most commonly used semiconductor material; and, ordinary skilled in the art should be able to recognize that the semiconductor in the device of Hshieh et al. (5,689,128) can be made of silicon.

Regarding claims 10-12, although Hshieh et al. (5,689,128) do not expressly disclose that the doping concentrations in the first and the second semiconductor layers form a graded profile, it is noted that the doping profile is a well recognized parameter of importance subject to routine experimentation and optimization.

Therefore, it would have been obvious to one of ordinary skilled in the art at the time the invention was made to make the semiconductor device of Hshieh et al. (5,689,128) with the doping concentrations in the first and the second semiconductor layers forming a graded profile through routine experimentation and optimization, so that low on-resistance and high breakdown voltage can be achieved.

Response to Arguments

9. Applicant's arguments with respect to claims 1-12 have been considered but are moot in view of the new ground(s) of rejection.

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Conclusion

10. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

11. Papers related to this application may be submitted to Technology center (TC) 2800 by facsimile transmission. Papers should be faxed to TC 2800 via the TC 2800 Fax center located in Crystal Plaza 4, room 4-C23. The faxing of such papers must conform with the notice published in the Official Gazette, 1096 OG 30 (November 15, 1989). The Group 2811 Fax Center number is (703) 308-7722 or 308-7724. The Group 2811 Fax Center is to be used only for papers related to Group 2811 applications.

Any inquiry concerning this communication or any earlier communication from the Examiner should be directed to ***Shouxiang Hu*** whose telephone number is **(703) 306-5729**. The

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Examiner is in the Office generally between the hours of 8:00AM to 5:30PM (Eastern Standard Time) Tuesday through Friday.

Any inquiry of a general nature or relating to the status of this application should be directed to the **Technology Center Receptionists** whose telephone number is **(703) 308-0956**.

Shouxiang Hu

July 21, 2000

SEE/TM/10/1
PRIORITY MAIL
GROUP 100

Steven Loh